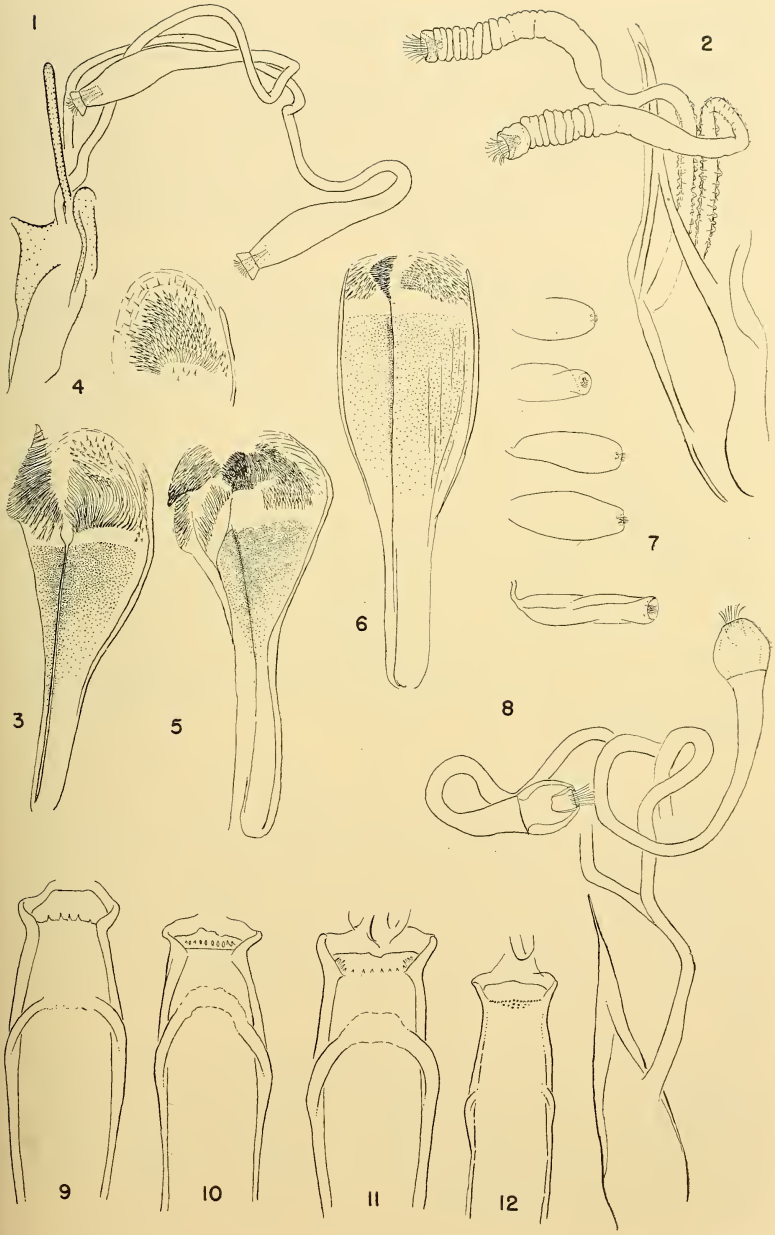
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styles, the males of *brevifiloides* and *pexopharynx* are unknown. All three species in which the females are known, *brevifilis*, *brevifiloides* and *pexopharynx* have definite teeth in the cibarium, not, in my opinion, rudimentary, while the male from New Guinea also has small horizontal and erect teeth. Both *buccinator* and the New Guinea species have a well-developed aedeagus or penis sheath, while the spermathecae of *pexopharynx* are quite unlike those of *brevifilis* and *brevifiloides*. Except for the erect abdominal hairs, these species could fit as well into *Sergentomyia* sensu Theodor as into *Phlebotomus*. The parameres of the males, the cibarial teeth, type of pharyngeal armature and the two types of spermathecae can nearly all be matched among various species placed by Theodor in *Sergentomyia*. It seems best, therefore, at least for the time being, to refrain from placing these species in any definite restricted category.

Phlebotomus brevifiloides, sp. nov. (Figs. 2, 6, 11, 67.)

Female. Wing length 2·1 to 2·2 mm. Abdominal hairs apparently erect. No post-spiracular setae on thorax. Mesonotum very slightly infuscated. Antennae lacking in all the specimens and only the basal palpal segments present. Proboscis long, greater than head height. Pharynx as figured, broad and well sclerotized. Cibarium as figured, the lateral teeth slender and transparent. Wing as figured. Spermathecae as figured, their posterior terminations not certainly visible, but probably opening separately into the vagina, at most with a very short common duct. Gonapophyses of the eighth sternite small and slender. Cerci short, moderately pointed.

Holotype female, slide 1414, and five female paratypes, slides 1412, 1413 and 1415 to 1417, Yass, New South Wales, Australia, March 1933, K. English coll.

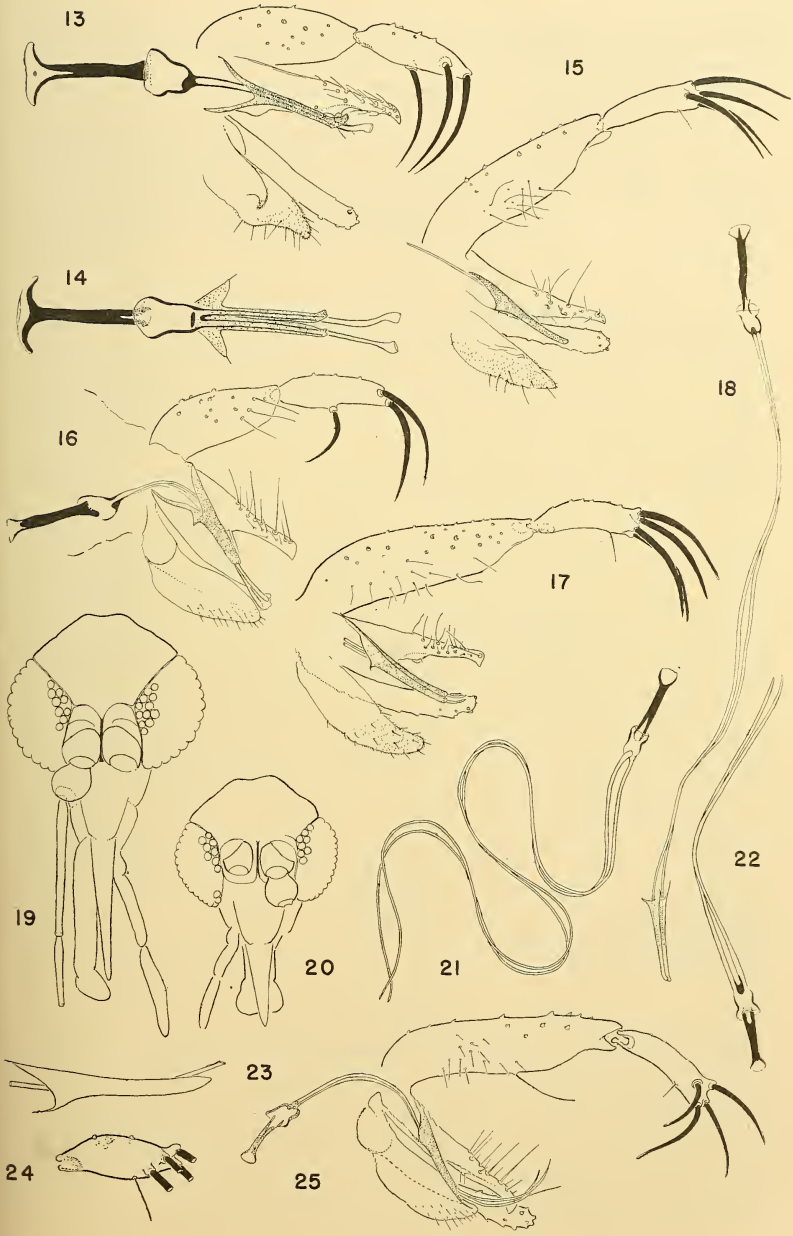
This species differs from *brevifilis* Tonn. only in the structure of the cibarium and pharynx, *brevifilis* having a much greater development of the spinose area in the pharynx but fewer horizontal teeth and no lateral teeth in the cibarium. The spermathecae of our single specimen of *brevifilis* are somewhat shrunken and distorted, so that detailed comparisons are not possible, though they appear to have been very similar to those of *brevifiloides*. The finding of two such closely related females at Yass raises some question as to the status of the male described by Tonnoir. It is very probable that he correctly associated the sexes, as his figure of the male pharynx shows it to be more spinose than would be expected of the male of the present species. Further intensive collecting may turn up the male of *brevifiloides* and indicate that the species are ecologically separated.

Phlebotomus buccinator, sp. nov. (Figs. 13, 14, 48, 66.)

Male. Wing length 1·5 to 1·6 mm. Abdominal hairs apparently erect. No setae on the upper margin of the anepisternum (post-spiracular setae). Mesonotum very slightly infuscated. Ascoids simple, shorter than their respective segments, paired on all segments where it has been possible to see them, at least to segment IX. Proboscis as long as head height. Pharynx slender, not strongly pigmented, armed only with weak denticulate ridges and short digitate processes. Cibarium as figured, without horizontal or vertical teeth, but with a few fine transparent lateral teeth. Wing, palpi and basal antennal segments as figured. Genitalia as figured, the style with three strong spines but no accessory setae, parameres hooked, aedeagus long, cylindrical, the apices up-turned, heavily sclerotized. Genital filaments short, only a little longer

Text-figs. 13-25.

Fig. 13, *P. buccinator* holotype, genitalia, lateral aspect.—Fig. 14, same, genital pump, dorsal aspect.—Fig. 15, *P. sansaporensis* allotype, genitalia.—Fig. 16, *P. papuensis* paratype, genitalia.—Fig. 17, *P. fergusoni*, genitalia of specimen with short delta wing.—Fig. 18, *P. hoogstraali*, allotype, genital pump and filaments.—Fig. 19, *P. pexopharynx* holotype, head in frontal aspect.—Fig. 20, *P. queenslandi* female, head in frontal aspect.—Fig. 21, *P. dolichobyssus* allotype, pump and genital filaments, the latter drawn from measurements.—Fig. 22, *P. fergusoni*, pump and genital filaments of same specimen as Fig. 17.—Fig. 23, *P. dolichobyssus* allotype, aedeagus × 290.—Fig. 24, *P. hoogstraali* allotype, style.—Fig. 25, *P. quintus* paratype, genitalia. All figures except Fig. 23 and the two heads are drawn to the same scale, approximately × 215. The heads are about × 72.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than the pump, their tips expanded. Pump very large and heavy, the plunger with its anterior end greatly expanded, trumpet-shaped. Lateral lobes simple, unarmed, straight, but little longer than the cerci which are rather acutely pointed.

Holotype male, slide 1407, and three paratype males, slides 1404 to 1406, Cairns, North Queensland, Australia, no date, C. B. Philip coll.

This species differs from *brevifilis* in having a long and heavily sclerotized aedeagus, a larger and stouter genital pump, and in having the spines on the style rather differently arranged. It is possible that this is the male of *P. pexopharynx*, n. sp., but the reduced lateral teeth in the cibarium of that species and the lack of spines in the pharynx of *buccinator* coupled with the long spermathecal ducts of *pexopharynx* and the short genital filaments of *buccinator* make it seem inadvisable to pair them without further evidence.

PHLEBOTOMUS PEXOPHARYNX, sp. nov. (Figs. 5, 8, 10, 19, 46, 65.)

Female. Wing length 2·01 mm. Abdominal hairs apparently erect. No post-spiracular setae on thorax. Mesonotum very slightly infuscated. Palpi and basal antennal segments as figured. Ascoids apparently paired on the flagellar segments, but collapsed and distorted in the single available specimen. Proboscis long, greater than head height. Pharynx and cibarium as figured, the latter with scarcely visible vestiges of lateral teeth, not shown in the figure. Spermathecae as figured, the ducts not visible in their entirety but probably little longer than shown.

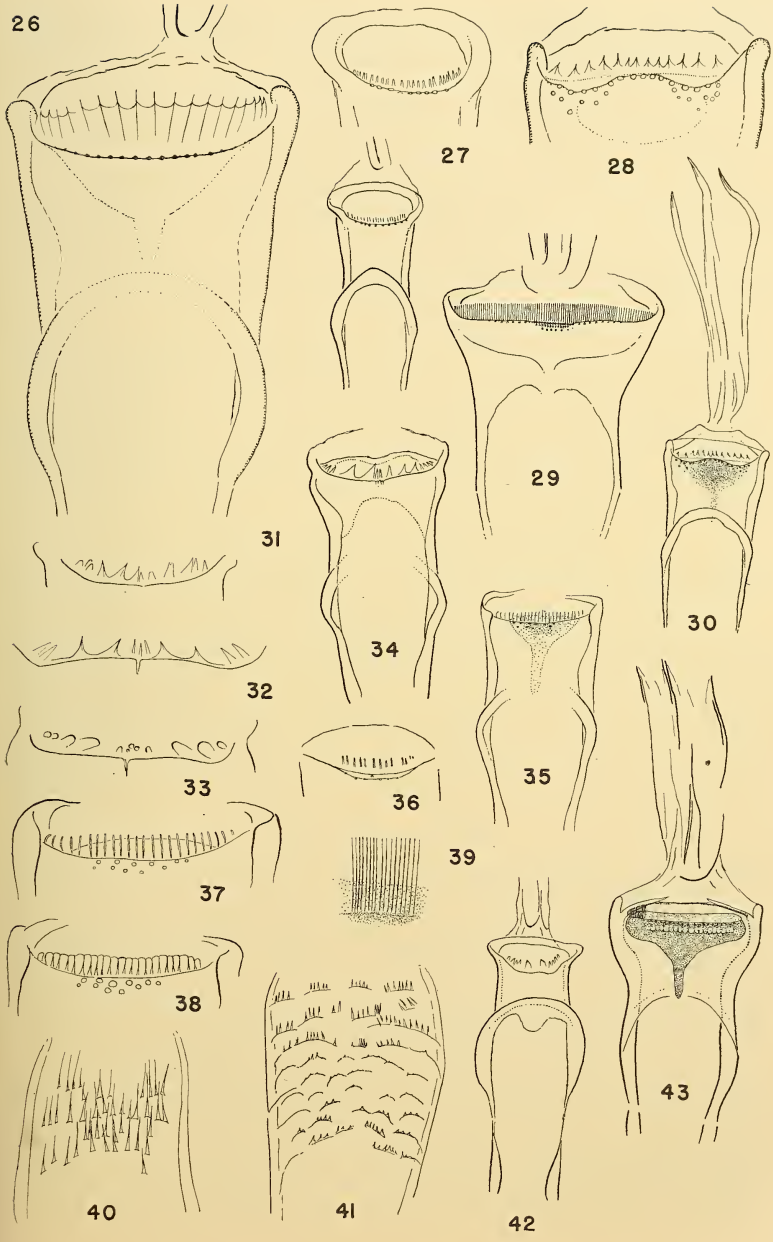
Holotype female, slide 1410, Cairns, N. Queensland, Australia, no date. C. B. Philip coll.

This species differs from *brevifilis* and *brevifiloides* externally in having a somewhat broader wing and relatively longer delta. The cibarium has more, about 10, and stouter teeth, and the lateral fine teeth are vestigial. The pharynx is somewhat like that of *brevifilis*, but the spines on the ventral or posterior plates are shorter and more numerous, less hair-like, while those on the dorsal or anterior plate are smaller and more closely set. The whole pharynx is more abruptly widened posteriorly, almost racquet-shaped. The spermathecae are of a quite different type from the other species, globular, apparently thick-walled, and with long smooth ducts.

The following three species are all rather closely related and are placed by Theodor (1948) in the genus *Sergentomyia*. This group is the "*minutus* group" or *Prophlebotomus* of previous workers and has usually been considered of no more than subgeneric rank. The species differ from the other Australian species considered in having the abdominal hairs mostly recumbent, the style of the male genitalia with four spines grouped near the apex, and a single more basal accessory seta. The spermathecae of the known Australian species are thin-walled oval or elliptical capsules with the terminal "knob" very small and sunk in a pit. The cibaria are provided with a comb-like series of fine horizontal teeth in both sexes, and the pharynges are armed with denticulate scales or slender hair-like spines. The Australian species are all small, generally markedly smaller than the *brevifilis* group, and usually with narrower wings. The proboscides are also relatively shorter, not or scarcely equalling the head

Text-figs. 26-43.

Fig. 26, *P. noemforensis* female paratype, cibarium × 650.—Fig. 27, *P. quintus* male paratype, cibarium, upper × 650, lower × 290.—Fig. 28, *P. hoogstraali* female holotype, cibarium × 650.—Fig. 29, *P. englishi moresbyi* female holotype, cibarium × 290.—Fig. 30, *P. hoogstraali* female holotype, cibarium × 290.—Fig. 31, *P. fergusoni* male allotype, cibarium × 650.—Fig. 32, *P. fergusoni* female paratype, cibarium × 650.—Fig. 33, *P. fergusoni* female, cibarium showing common appearance of teeth at other than critical focus, × 650.—Fig. 34, *P. fergusoni* female, holotype, cibarium × 290.—Fig. 35, *P. sansaporensis* female paratype, cibarium × 290.—Fig. 36, *P. sansaporensis* male paratype, cibarium × 650.—Fig. 37, *P. sansaporensis* female paratype, cibarium × 650.—Fig. 38, same, at other than critical focus, the usual appearance in poorly cleared specimens, × 650.—Fig. 39, *P. dolichobyssus* female holotype, segment of cibarial tooth row × 1300.—Fig. 40, *P. queenslandi* female, apex of pharynx × 650.—Fig. 41, *P. englishi* female, apex of pharynx × 650.—Fig. 42, *P. brachycornutus* female holotype, cibarium × 290.—Fig. 43, *P. dolichobyssus* female holotype, cibarium × 290.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height. Most species of the group do not bite man, but are believed to feed mainly on cold-blooded vertebrates. Tonnoir recorded (1935) Miss English's observations on *englishi* and *queenslandi meridionalis*, which fed readily on lizards but refused human blood, while *brevifilis* would bite both man and lizards.

PHLEBOTOMUS ENGLISHI Tonnoir. (Fig. 41.)

1935, *Bull. Ent. Res.*, 26:144–145, fig. 3, Plate I, figs. *f*, *g*. (♂, ♀; Yass, New South Wales, Australia.)

Sergentomyia (*Sergentomyia*) *englishi* Theodor, 1948, *Bull. Ent. Res.*, 39 (1):111.

One male and one female, Yass, New South Wales, March 1933, K. English coll. There is little to add to Tonnoir's description of the species, but we give here figures of the pharyngeal armature of the female, as his photographs are not very clear on this point. The male armature is difficult to see in the single specimen, but appears to consist of groups of longer and more slender spines arising from similar, but less clearly marked, ridges or scales like those in the female.

PHLEBOTOMUS QUEENSLANDI Hill. (Figs. 20, 40.)

1923, *Bull. Ent. Res.*, 14:83–86, 6 figs. (♂, ♀; Townsville, N. Queensland.) Tonnoir, 1935, *Bull. Ent. Res.*, 26:140–142, figs. 2A, B, 3C (redescribed from the type series).

Sergentomyia (*Sergentomyia*) *queenslandi* Theodor, 1948, *Bull. Ent. Res.*, 39 (1):111.

One female, Cairns, N. Queensland, C. B. Philip coll., agrees with Tonnoir's description and figures. We give here a figure of the pharyngeal armature for comparison with *englishi*, but have nothing to add to Tonnoir's full description except to note the presence of fairly numerous erect teeth in the cibarium below the comb of horizontal teeth.

PHLEBOTOMUS QUEENSLANDI MERIDIONALIS Tonnoir.

1935, *Bull. Ent. Res.*, 26, 142–143, fig. 3A, a, Pl. I, fig. *c*. (♂, ♀; Yass, New South Wales.)

Sergentomyia (*Sergentomyia*) *queenslandi* var. *meridionalis* Theodor, 1948, *Bull. Ent. Res.*, 39 (1):111.

One female, Yass, New South Wales, March 1933, K. English coll. The specimen agrees with Tonnoir's description. The pharyngeal armature is essentially like *queenslandi*, though the teeth seem somewhat shorter. The pharynx is not in the best position, however, and this may be an illusion. The cibarial teeth are quite different: longer and more numerous. I count 77 on this specimen, which agrees fairly well with Tonnoir's "about 80". There is also a single complete transverse row and part of a second row of stout erect teeth below the fine comb of horizontal teeth, as in *queenslandi*. Only further careful study of good series of these two forms from intermediate localities will show whether they are good species or geographical races.

2. The New Guinea Species.

Aside from the mention by Tonnoir (1935) of a single specimen from Port Moresby, no *Phlebotomus* have been hitherto known from New Guinea, although they appear to be fairly abundant and widespread there. The 300 odd specimens taken by Ferguson and Graham appear to be separable into not more than 19 species, none of which agree with previously described forms from elsewhere. Of these, 9 species are represented by sufficiently well preserved material to warrant description. The remainder can be seen to be distinct but are too poorly preserved for figures to be made or complete descriptions to be drawn up, and a residue of about 25 specimens are quite indeterminable, though probably belonging to one or another of the describable species.

The fauna is like that of Australia in lacking any representatives of the more typical groups of *Phlebotomus*, with one exception the species all belonging to the *minutus* group (*Sergentomyia*). Only two species, however, *papuensis*, n. sp., and *englishi moresbyi*, n. subsp., appear to be at all closely related to Australian species, the former being the only representative of the *brevifilis* group (*Australophlebotomus*) known outside of Australia. Of the remaining species, all have unarmed pharynges and oval or elliptical unsegmented spermathecae, but only a few can be placed with confidence in any of Theodor's (1948) groups of the genus *Sergentomyia*.

The relative paucity and lack of diversity in the Australasian fauna is of considerable interest, as it seems to indicate that the group had its origins elsewhere. Except for the *brevifilis* group, which seems to be a local Australian development, the species are similar in general to the other Old World Sergentomyias, failing to show either any marked "primitive" characteristics or any marked local modifications. There is no such wealth of bizarre developments as is found in the Neotropics, for example. It is interesting to note that no *Phlebotomus* are so far known from Chile, whose insect fauna in many groups shows such close affinity with that of Australia.

In the following list those species of which material is too fragmentary or too poorly preserved to warrant description are noted. All the species belong to the *minutus* group, and are to be separated very largely on small characters of the cibarium, antennae, etc. With two exceptions they are represented by single specimens and nearly all are very inadequate mounts, having been long in alcohol. The series from Biak and Owi Islands might have been described, but there is not a single really good specimen in the lot and the species is very close indeed to *sansaporensis*. These insects are difficult enough to separate at best, and I do not wish to add to the difficulty by perpetuating any names based on inadequate type material.

1 ♂. Dobadura, 22 Sept. 1944. Slide 2809. Cibarium with a comb of about 15 teeth. Genital filaments about 4 times as long as pump. Segment III of antennae about as long as first three palpal segments. Delta short, less than half alpha. This and the following males all have genitalia of the same type, like *sansaporensis*.

1 ♂. Aitape, 16 Sept. 1944. Slide 2654. Cibarium not visible. Genital filaments about 2·5 times as long as pump. Segment III of antennae slightly longer than first three palpal segments. Delta short, less than half alpha.

1 ♂. Dobadura, 21 Sept. 1944. Slide 2700. Cibarium broad, with a comb of at least 12 long teeth. Genital filaments about 7 times as long as pump. Segment III of antennae about equal to first three palpal segments. Delta short.

1 ♂. Sansapor, 11 Sept. 1944. Slide 2830. Cibarium broad, teeth indistinct, though apparently short and numerous. Genital filaments about 7 times as long as pump. Segment III of antennae very long, at least one-quarter longer than first three palpal segments. Delta short.

1 ♂. Dobadura, 7 Aug. 1944. Slide 1141. Cibarial teeth not visible, chitinous arch present. Genital filaments about 4 times as long as pump. Segment III of antennae about as long as first three palpal segments. Delta short. This may be same as Slide 2809.

14 ♂, 8 ♀. Biak and Owi Islands, 13 Sept. 1944, and 1 ♂ without data. The males have a faint comb of small teeth, while the cibarium of the female is similar in appearance to that of *sansaporensis*, though it appears to have fewer teeth. Genital filaments 3 to 3·5 times as long as pump. Segment III of antennae a little shorter than first three palpal segments. Delta short or minus.

1 ♀. Dobadura, 18 Aug. 1944. Slide 3517. Cibarium of about 22 teeth. Chitinous arch discernible at sides. Segment III of antennae about equal to first three palpal segments. Delta short.

2 ♀. Sansapor, 11 Sept. 1944. Slides 1149, 1152. Cibarium of about 26 teeth. Chitinous arch not visible. Spermatheca oval, thin walled, the terminal knob sunk in a pit. Antennae and palps missing. Delta long, half or more alpha.

1 ♀. Dobadura, 21 Sept. 1944. Slide 2713. Cibarium very broad with about 39 slender teeth, no chitinous arch. Segment III of antennae about three-fourths as long as first three palpal segments. Delta short.

1 ♀. Hollandia, 6 Sept. 1944. Slide 2824. Cibarium with fairly numerous very short teeth, not clear enough to count. No chitinous arch. Segment III of antennae shorter than first three palpal segments. Delta short. Mesonotum quite strongly infuscated.

Key to Males.

1. Style with 3 well-developed spines, 2 apical and 1 median. Genital filaments less than twice as long as pump. No post-spiracular setae, but a few small setae on lower border of mesanepisternum. Wing quite broad ..... *papuensis*
   Style with 4 well-developed spines, all beyond middle, and an accessory seta proximal to the spines. Genital filaments at least twice length of pump. No pleural setae on thorax. Wing very narrow ..... 2.
2. Style rather short, hardly 3 times as long as wide, with one of the more basal pair of spines quite widely separated from the other and the accessory seta at about middle of segment. Genital filaments about 6 times as long as pump ..... *hoogstraali.*
   Style longer, more cylindrical, about 4 times as long as wide, with all spines grouped close to the apex and the accessory seta inserted beyond middle of segment ..... 3.
3. Genital filaments at least 9 times as long as pump. Aedeagus rather long and broad. Cibarium with numerous short teeth in a straight row and a strong chitinous arch ..... *dolichobyssus.*
   Genital filaments less than 5 times as long as pump ..... 4.
4. Cibarium with rather irregular, large, triangular teeth, about 12 in number. Chitinous arch fairly well marked. Genital filaments about 4 times as long as pump ..... *fergusoni.*
   Cibarium with small slender teeth in a fairly regular row ..... 5.
5. Chitinous arch well developed, the whole cibarium heavily sclerotized. Genital filaments about 4 times as long as pump ..... *quintus.*
   Chitinous arch weak, obsolete in the middle. Genital filaments less than 4 times as long as pump ..... 6.
6. Genital filaments about 3 times as long as pump. Cibarial teeth fine, comb-like ..... *sansaporensis.*
   Genital filaments about twice as long as pump. Cibarial teeth more triangular, somewhat divergent from the centre ..... *noemforensis.*

Key to Females.

1. Cibarial teeth irregular in size and position ..... 2.
   Cibarial teeth in a regular comb of even subequal teeth ..... 3.
2. Cibarium with 4 large triangular teeth and a variable number of more slender teeth in the middle and at sides. Chitinous arch practically absent. Spermathecae oval, thin-walled, the terminal knob sunk in a pit. Delta at least half alpha ..... *fergusoni.*
   Cibarium with two large blunt teeth in the middle and a variable number of smaller teeth at the sides. Chitinous arch very prominent. Delta short, less than half the short alpha. Segment III of antennae very short, about equalling fourth palpal segment. Spermathecae as above ..... *brachycornutus.*
3. Cibarium with very numerous, 70 or more, fine teeth ..... 4.
   Cibarium with less than 30 teeth ..... 5.
4. Cibarium exceedingly broad, with about 80 long slender teeth. Pharynx broad, armed with groups of short spines. Chitinous arch absent. Segment III of antennae shorter than fourth palpal segment ..... *moresbyi.*
   Cibarium narrower, but with about 125 long hair-like teeth and a strong broad pigment patch. Chitinous arch weakly developed. Pharynx slender, unarmed. Segment III of antennae considerably longer than fourth palpal segment ..... *dolichobyssus.*
5. Cibarium with about 24 slender peg-like teeth. Chitinous arch obsolete in the middle ... . *sansaporensis.*
   Cibarium with less than 20 spine-like teeth ..... 6.
6. Cibarium with about 18 long slender teeth joined nearly to their tips. Erect teeth small, in a single transverse row. Pigment patch more or less triangular. Chitinous arch faint in the middle ..... *noemforensis.*
   Cibarium with about 13 short triangular teeth. Erect teeth large and numerous, not in an even row. Pigment patch oval, with a slender tail. Chitinous arch well sclerotized throughout ..... *hoogstraali.*

PHLEBOTOMUS PAPUENSIS, sp. nov. (Figs. 12, 16, 50, 63.)

Male. Wing length 1·53 to 1·67 mm. Dorsal abdominal hairs erect, as are those on the sternites. No post-spiracular setae. Mesonotum very slightly infuscated. Proboscis, from level of base of palpi to apex, about one-quarter less than head height from base of clypeus to vertex. Palpi and basal antennal segments as figured. Newstead's scales in a loose patch a little proximal to the middle of the third segment. Ascoids simple, long, paired at least to segment X and probably further. Pharynx slender, weakly sclerotized, not obviously spinose, but with faint indications of numerous small denticles at its posterior end, hardly visible in the poorly stained mounts. Cibarium as figured. Genitalia as figured, with two nearly terminal and one median spine but no accessory seta on the style. Aedeagus well sclerotized, slender, with a

triangular ventral extension near the base, not visible in all specimens, and probably representing a sclerotized area extending onto the base of the paramere. Paramere simple, with a small internal ventral triangular excrescence, not shown in the figure, as it lies behind the aedeagus. Genital pump large, with flaring plunger, the filaments rather stout, simple, their apices finely and faintly annulate, less than twice as long as the pump.

Holotype male, slide 1254, and 5 male paratypes, slides 1251–1253, 1255–1256, Dobadura, Oro Bay, Papua, 7 Aug. 1944, Ferguson and Graham colls. Taken in tree holes. One male paratype, slide 1128, same locality, 18 Aug. 1944, and 1 male paratype, slide 2666, same locality, 21 Sept. 1944.

There seem to be no females which can be associated with these males with certainty. The relatively very long antennal segments, especially the first flagellar, and the long palpi, combined with the broad wing and presence of setae on the lower border of mesanepisternum would seem to make the recognition of the female comparatively simple. This species seems clearly related to the Australian species with similar genitalia, *brevifilis* and *buccinator*, differing from the former in the long aedeagus, and from the latter in the less sclerotized aedeagus, more slender genital pump, arrangement of the spines on the style, and arrangement of the teeth in the cibarium.

PHLEBOTOMUS ENGLISHI subsp. MORESBYI, subsp. nov. (Figs. 29, 53, 71.)

Female. Wing length 1·56 mm. Dorsal abdominal hairs recumbent, those on the sternites possibly semi-erect on the margins. Mesonotum slightly infuscated. Pleural area not well preserved, probably without setae. Proboscis less than head height from vertex to base of clypeus. Palpi and basal antennal segments as figured. The very short antennal segments are noteworthy. Newstead's scales in a large dense patch on the proximal third of the third palpal segment. Ascoids simple, rather stout and relatively long, paired on all segments except the terminal one. Pharynx lamp-glass shaped, armed with short spines set in groups on short arcs, exactly as in *englishi*. Cibarium very broad, armed with a comb of very numerous fine horizontal teeth, about 80, and with a considerable number of not very distinct small vertical teeth. Spermathecae not visible in the single mount.

Holotype female, slide 1048, Port Moresby, 12-mile swamp, Papua, 13 Aug. 1944, Ferguson and Graham colls., taken in a tree hole or buttress.

This species is exceedingly close to *P. englishi* Tonn. from New South Wales, differing only in having an even shorter antennal segment III, ·112 mm. as against a minimum of ·134 given by Tonnoir for *englishi*; in a shorter alpha, ·240 mm., and delta, ·088 mm. as against minimum measurements of ·252 and ·091 respectively for *englishi*; in shorter wing-length, 1·56 mm. as against 1·70 mm. for *englishi*, and in having fewer teeth in the cibarial comb, 80 instead of 85. These differences are hardly sufficient grounds for erecting a species, yet the great differences in locality seem to call for some sort of recognition, hence the subspecific status. Further material from Papua and Australia may well make the name superfluous.

There is a single male, slide 3522, Port Moresby, 12-mile swamp, 12 Aug. 1944, which may be the male of *moresbyi*. It has similar wing measurements, length 1·35 mm., alpha ·184, delta ·036, and a short third antennal segment, ·120 mm. The pharynx bears spines set on short arcs, as in *moresbyi*, but the cibarium has but 12 rather broad-based triangular horizontal teeth. The genitalia lie in dorso-ventral position, but appear to have a style with four nearly terminal spines and the usual accessory seta. The genital filaments are twisted about the aedeagus, but appear to be at least three and possibly more times as long as the pump. The aedeagus is slender, hardly half as long as the parameres. The parameres do not appear to have the terminal ventral beak found in most species of this group, but this may be due to the position in which they are mounted. If this is truly the male of *moresbyi*, it is very different from male *englishi* and indicates that the two forms are distinct. However, the only available specimen is not adequate for accurate description and the association must remain tentative for the present.

PHLEBOTOMUS HOOGSTRAALI, sp. nov. (Figs. 1, 18, 24, 28, 30, 59, 60, 75.)

Female. Wing length 1·63 to 1·75 mm. Dorsal abdominal hairs mostly recumbent, but with a few erect hairs on the posterior margins of all tergites and the margins of all sternites. No post-spiracular or other pleural setae. Mesonotum very slightly infuscated. Proboscis short, less than head height from vertex to base of clypeus. Palpi and basal antennal segments as figured. Ascoids apparently paired on at least the basal flagellar segments, though only their bases seen with certainty. Newstead's scales in a small dense patch on the proximal third of the third palpal segment. Cibarium and pharynx as figured, the latter without visible armature of spines or scales. Wing as figured. Spermathecae as figured. Gonapophyses of eighth sternite short and slender.

Male. Wing length 1·44 mm. Externally like the female except that delta is relatively shorter and there appears to be but a single ascoid on each of the antennal segments. Cibarium with about eight small horizontal teeth. Male genitalia of the usual type for this group, but the style with one of the spines considerably more proximal than the others, as figured. Inner aspect of coxites with rather numerous fine setae. Aedeagus slender and pointed. Pump and genital filaments as figured, the filaments about 6 times as long as the pump.

Holotype female, slide No. 1446, Hollandia, Dutch New Guinea, January 1945. Taken at light. H. Hoogstraal coll.

Allotype male, slide 1445, and 1 paratype female, slide 1447, same data as holotype.

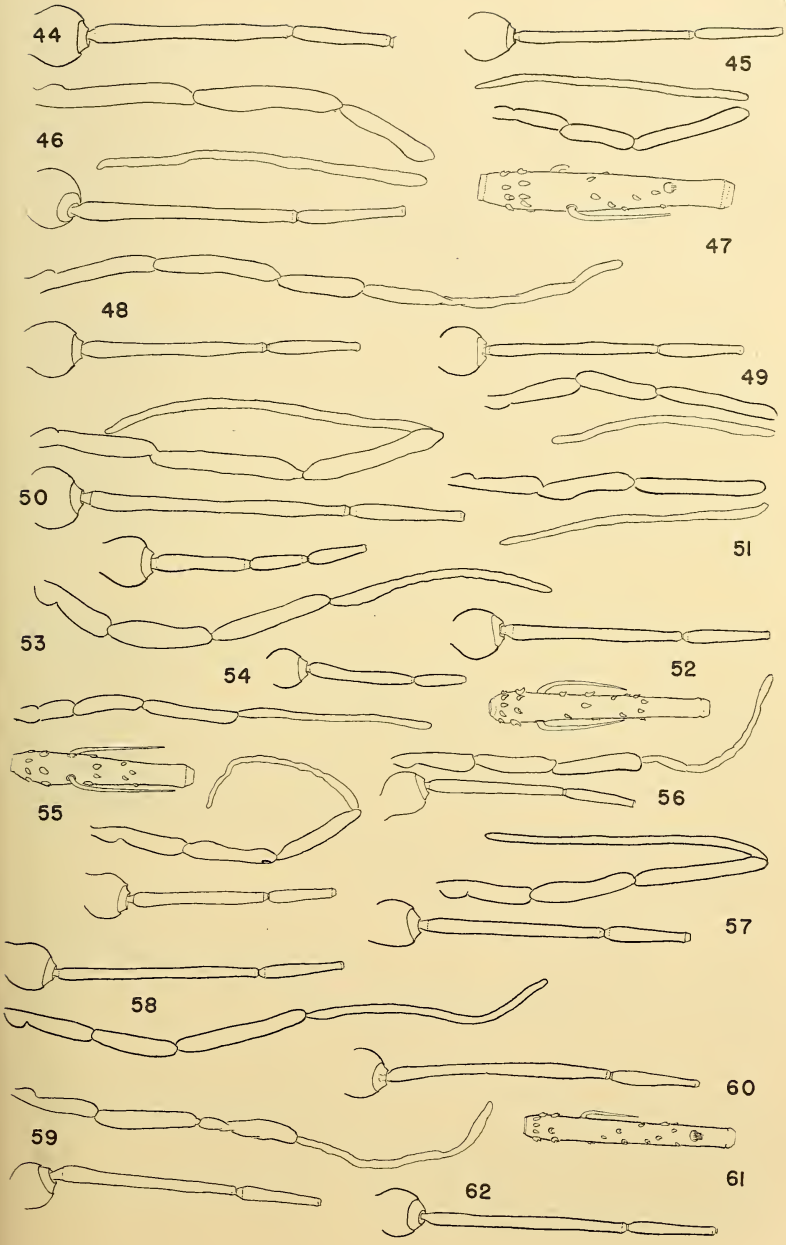
The sexes of this species are associated on the basis of the collecting data, the general similarity of external structures, and the long genital filaments and long spermathecal ducts, not conclusive evidence, but the best that can be done at present. This species will go into Theodor's "group *africana*" of the genus *Sergentomyia*, subgenus *Sergentomyia*, except that the cibarial armature is of the type found in *P. zeylanicus* with erect teeth as well as pointed horizontal teeth. The pharynx is lamp-glass shaped, but bears no visible teeth or spines.

PHLEBOTOMUS DOLICHOBYSSUS, sp. nov. (Figs. 7, 21, 23, 39, 43, 55, 56, 68, 70.)

Female. Wing length 1·26 to 1·33 mm. Dorsal abdominal hairs recumbent, except for a patch of erect setae on the first tergite and a few scattered erect setae on the posterior margins of the succeeding tergites. Sternites with semi-recumbent setae. Mesonotum moderately infuscated. No pleural setae. Proboscis longer than head height from vertex to base of clypeus. Palpi and basal antennal segments as figured. Newstead's scales in a dense patch on proximal third of third palpal segment. Ascoids as figured, long and slender, paired on all but the terminal segment, from which they appear to be absent. Pharynx unarmed, fairly well sclerotized, as figured. Cibarium broad and heavily sclerotized, no chitinous arch, a very large and dense pigmented area and a comb of exceedingly fine and numerous hair-like horizontal teeth and what appear to be several rows of erect or semi-erect teeth below, much obscured by the pigment patch. The teeth in the comb are so fine and numerous that it has not been possible to count

Text-figs. 44-62.

Fig. 44, *P. brevifilis* female, basal antennal segments.—Fig. 45, *P. fergusoni* male, short delta wing, basal antennal segments and palpus.—Fig. 46, *P. pexopharynx* female holotype. antenna and palp.—Fig. 47, *P. brevifilis* female, antennal segment showing ascoids.—Fig. 48, *P. buccinator* male holotype, antenna and palp.—Fig. 49, *P. sansaporensis* female paratype. antenna and palp.—Fig. 50, *P. papuensis* male paratype, antenna and palp.—Fig. 51, *P. noemforensis* female holotype, antenna.—Fig. 52, same, palp and antennal segment VII showing ascoids.—Fig. 53, *P. englishi moresbyi* female holotype, antenna and palp.—Fig. 54, *P. brachycornutus* female holotype, antenna and palp.—Fig. 55, *P. dolichobyssus* female holotype, ascoids. antenna and palp.—Fig. 56, same, male allotype, antenna and palp.—Fig. 57, *P. fergusoni* female holotype, antenna and palp.—Fig. 58, *P. quintus* male paratype, antenna and palp.—Fig. 59, *P. hoogstraali* female holotype, palp and antenna.—Fig. 60, same, male allotype. antenna.—Fig. 61, *P. sansaporensis* male allotype, antennal segment IV showing ascoid.—Fig. 62, *P. fergusoni* male allotype, antenna. All figures of basal antennal segments and palpi are to the same scale, approximately × 145. Figures of single antennal segments to show ascoids are at greater magnification, about × 290.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them accurately, but they are estimated to number about 125. Spermathecae somewhat distorted, as figured, the ducts long, at least five and probably more times as long as the spermathecae and apparently opening separately into the vagina, although they are visible with great difficulty in the available material.

Male. Wing length 1·11 to 1·20 mm. Abodminal setae and colour as in the female. Proboscis slightly less than head height. Palpi and basal antennal segments as figured. Newstead's scales as in female, though fewer. Ascoids small and slender, apparently single on segments III to VII, paired on IX to XIII, remaining segments missing. Where paired, one ascoid is larger than the other. Cibarium as figured. Pharynx as in the female, but more slender. Genitalia characteristic of the group, but the genital filaments exceedingly long, between 9 and 10 times as long as the pump, as figured.

Holotype female, slide 1209, Hollandia, Dutch New Guinea, 6 Sept. 1944, in buttresses of forest trees. Ferguson and Graham coll.

Allotype male, slide 1208, same data as holotype.

Paratypes, 2 males, slides 2820, 2821 and 2 females, slides 2823, 2825, same data as holotype; 1 male, slide 2793, Hollandia, 16 Oct. 1944, in buttresses, 24th Malaria Survey Unit colls.; 1 male, slide 1449, and 1 female, slide 1448, Hollandia, Jan. 1945, at light, H. Hoogstraal coll.; 1 male, Hollandia, Feb. 1945, 1 female, no data, L. E. Rozeboom coll., 1 female, slide 2655, Aitape, 16 Sept. 1944, in buttress, 5th Malaria Survey Unit.

On the basis of the cibarial structure, this species would go into Theodor's "group *minuta*" of the genus *Sergentomyia*, but the type of spermatheca, unarmed pharynx and slender aedeagus indicate closer relationships with his "group *africana*". It is to be distinguished from *hoogstraali* on the structure of the style, longer genital filaments, shorter third antennal segment and very different cibarium. From *englishi moresbyi* it can be separated by the more numerous cibarial teeth and the longer third antennal segment.

PHLEBOTOMUS BRACHYCORNUTUS, sp. nov. (Figs. 7, 42, 54, 64.)

Female. Wing length about 1·17 mm., though both wings are somewhat distorted. Dorsal abdominal hairs mostly recumbent, though some erect hairs present on the posterior margins of tergites I, VI and VII. Sternites mostly with erect hairs and a few semi-recumbent lorate scales. Mesonotum apparently pale, though much broken and distorted. Proboscis greater than head height from vertex to base of clypeus. Third antennal segment and basal palpal segments unusually short, as figured. Ascoids simple, short, paired on at least the first five flagellar segments. Newstead's scales in a dense patch on the proximal third of the third palpal segment. Pharynx moderately well sclerotized and somewhat expanded posteriorly, without visible teeth, hairs, scales or spines, obscurely ridged. Cibarium as figured, the high and heavily sclerotized chitinous arch being especially characteristic. Spermathecae simple thin-walled oval structures, the ducts not discernible in the single specimen.

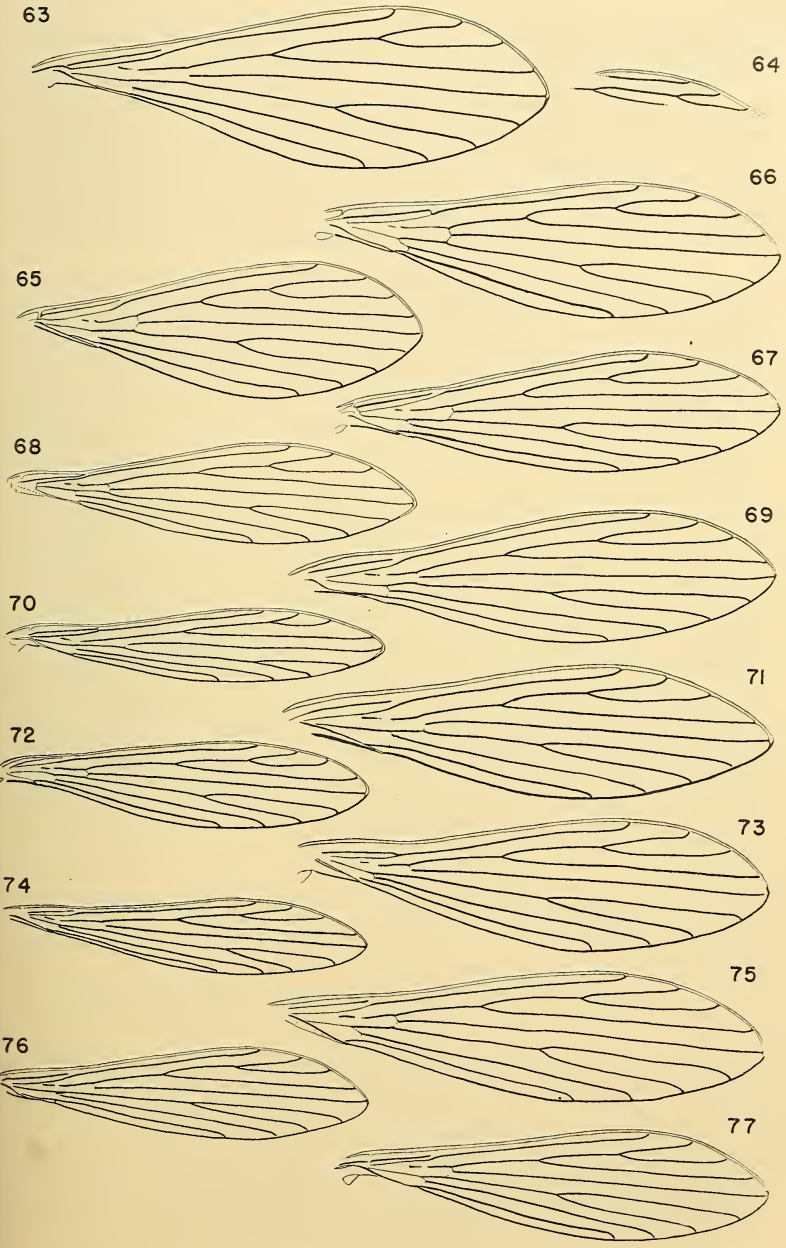
Holotype female, slide 1195. Toem, Dutch New Guinea, 9 Sept. 1944. Taken in buttress of forest tree.

PHLEBOTOMUS FERGUSONI, sp. nov. (Figs. 7, 17, 22, 31–34, 45, 57, 62, 69, 72, 77.)

Female. Wing length 1·386 to 1·710. Dorsal abdominal hairs recumbent, hairs on lateral and posterior margins of sternites apparently semi-erect. No post-spiracular or other pleural setae. Mesonotum very slightly infuscated. Proboscis less than height of head from vertex to base of clypeus. Palpi and basal segments of antennae as figured.

Text-figs. 63-77.

Fig. 63, *P. papuensis* male paratype.—Fig. 64, *P. brachycornutus* female holotype.—Fig. 65, *P. pexopharynx* female holotype.—Fig. 66, *P. buccinator* male holotype.—Fig. 67, *P. brevifloides* female holotype.—Fig. 68, *P. dolichobyssus* female holotype.—Fig. 69, *P. fergusoni* female holotype.—Fig. 70. *P. dolichobyssus* male paratype.—Fig. 71, *P. englishi moresbyi* female holotype.—Fig. 72, *P. fergusoni* short delta male.—Fig. 73, *P. noemforensis* female holotype.—Fig. 74, *P. sansaporensis* male paratype.—Fig. 75, *P. hoogstraali* female holotype.—Fig. 76, *P. quintus* male paratype.—Fig. 77, *P. fergusoni* male allotype. All figures are of wings and are to the same scale, × 52·5, except Figs. 65 and 67, which are to a somewhat smaller scale, × 34·5. Both the latter are considerably larger than *P. papuensis*.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Ascoids apparently paired on at least the basal antennal segments, short, thin-walled and impossible to see on the majority of specimens. Newstead's scales in a dense patch on the proximal third of the third palpal segment. Pharynx slender, poorly sclerotized, the proximal end with very weakly sclerotized denticulate ridges only visible under optimum conditions. Cibarium as figured, usually with four large teeth and a group of small slender teeth in the middle and at each side. The apparent number, shape and position of the teeth vary considerably, as shown in the figures. The appearance indicated by Figure 33 is often seen and appears to be due to the teeth being bent down into the lumen of the cibarium, i.e. away from the observer. Wing as figured, the length of delta relative to alpha varying considerably. Spermathecae as figured, the ducts not visible. Gonapophyses of eighth sternite short and slender. Cerci short and blunt.

Male. Wing length 1·29 to 1·44 mm. Externally similar to the female. Wing, basal antennal segments and palpi as figured. Ascoids apparently single on at least the basal segments, thin-walled and difficult to see. Cibarium similar to that of the female but narrower and the teeth smaller, as figured. Wing as figured, delta relatively shorter than in the female. Genitalia not distinguishable from other members of the group, the filaments a little more than four times as long as the pump.

Holotype female, slide 1192, Toem, Dutch New Guinea, 9 Sept. 1944, in tree buttresses. Ferguson and Graham colls.

Allotype male, slide 1317, Lae, North-east New Guinea, 16 Aug. 1944, in tree buttresses. Ferguson coll.

Paratypes, 56 females and 17 males from the following localities: Dobadura, Oro Bay, Papua, 26 July, 7, 8, 13, 18 August, and 21 and 22 September 1944 (29 ♀, 3 ♂); Lae, North-east New Guinea, 16 Aug. 1944 (1 ♂); Popendetta, Oro Bay, Papua, 7 October 1944 (3 ♀); Nadzab, North-east New Guinea, 15 August and 1 October 1944 (6 ♀, 6 ♂); Finschhafen, North-east New Guinea, 29 August 1944 (3 ♀, 4 ♂); Tumleo Island, off Aitape, 16 September 1944 (4 ♀, 1 ♂); Toem, Dutch New Guinea, 9 September 1944 (6 ♀); New Guinea, no other data (5 ♀, 2 ♂). All were collected from tree holes or the crevices between the buttressed roots of large forest trees by Majors Ferguson and Graham or members of the 5th Malaria Survey Unit, U.S. Army.

In addition to the above specimens, there is a long series of males (37) and a single female which agree with the above in what can be seen of the cibarium, in the male genitalia and in palpal and antennal lengths, but which differ in having a consistently smaller delta and alpha and shorter average wing length, though there is an overlap of about 10% in this measurement. The pertinent measurements in mm. are given below, taken from all available specimens.

Paratypes:

	15 Males.			56 Females.		
	Alpha.	Delta.	Wing Length.	Alpha.	Delta.	Wing Length.
Max. ..	·280	·144	1·440	·420	·256	1·710
Min. ..	·184	·060	1·260	·220	·080	1·386

Other specimens:

	37 Males.			1 Female.		
	Alpha.	Delta.	Wing Length.	Alpha.	Delta.	Wing Length.
Max. ..	·176	·044	1·314	·168	·044	1·404
Min. ..	·080	·040	1·134			

Whether this material represents another species or is merely a subjective segregate cannot be decided, as most of the specimens with short wing measurements were among those long preserved in alcohol and the mounts are very unsatisfactory. The cibaria of only a few of these can be seen clearly enough to make out the presence of several large teeth similar to those of the paratypes. The localities of these specimens are listed here: 20 males, Dobadura, 18 Aug. and 21 Sept.; 6 males, 1 female, Aitape, 16 Sept.; 3 males, Nadzab, October; 1 male, Tumleo Id., 16 Sept.; 1 male, Hollandia, 6 Sept.; 2 males, Port Moresby, 12, 13 Aug.; 16 males, Toem, 9 Sept.; 5 males, New

Guinea, no other data. Except for the material from Hollandia and Port Moresby, these specimens were taken mainly together with typical *fergusoni*. This species seems to be quite abundant in the eastern part of New Guinea, specimens having been taken in most of the localities where collecting was done from Toem in Dutch New Guinea to Dobadura in Papua. No specimens have been identified in the fairly abundant material from Sansapor on the north-western tip of Dutch New Guinea nor from the islands in Geelvink Bay. The species does not seem to be very closely related to any previously described, though it bears certain resemblances to *P. iyengari* Sint. and its various forms, sharing with them the unarmed pharynx and long delta. It differs, however, in having considerably fewer and more irregularly arranged teeth in the cibarium and in the simple, thin-walled spermathecae.

PHLEBOTOMUS QUINTUS, sp. nov. (Figs. 25, 27, 58, 76.)

Male. Wing length 1·29–1·42 mm. Dorsal abdominal hairs recumbent. No pleural setae. Mesonotum slightly infuscated. Proboscis short, a little less than head height. Palpi and basal antennal segments as figured. Ascoids short and slender, apparently single, on all segments except the terminal three, which are nearly globular. Newstead's scales in a small dense patch on proximal third of third palpal segment. Cibarium as figured, quite heavily sclerotized. Pharynx slender, weakly sclerotized, the apex unarmed but with faint irregular transverse ridges. Wing as figured. Genitalia as figured.

Holotype male, slide No. 1206, Hollandia, Dutch New Guinea, 6 Sept. 1944, in tree buttress.

Paratypes, 1 male, slide 1207, same data as holotype, and 3 males, slides 1044, 2683 and 2685, Finschhafen, at Mape River, North-east New Guinea, 29 Aug. 1944, in tree buttresses. All collected by personnel of the 5th Malaria Survey Unit, U.S. Army, in honour of which the species is named.

PHLEBOTOMUS SANSAPORENSIS, sp. nov. (Figs. 7, 15, 35–38, 49, 61, 74.)

Female. Wing length 1·45 to 1·53 mm. Mesonotum rather strongly infuscated. Dorsal abdominal hairs recumbent. Ventral hairs semi-recumbent. Proboscis less than head height. Third antennal segment and palpi as figured. Newstead's scales in a dense patch on the basal third of third palpal segment. Ascoids short and slender, paired on all segments except the last three, which are abruptly shortened. Pharynx not widened posteriorly, unarmed, with weak ridges and digitate processes. Cibarium as figured, with about 24 relatively short teeth whose apices appear to be bent down into the lumen of the cibarial cavity. It is possible that these teeth represent thickenings on an otherwise tenuous membrane. At other than critical focus the refractive pattern shows a series of broad blunt contiguous structures quite characteristic for the species and easily seen in even the poorest mounts. Spermathecae distorted, apparently simple oval thin-walled capsules, as figured.

Male. Wing length 1·20 to 1·22 mm. Similar to female but alpha and especially delta relatively shorter than in female. Ascoids shorter and more slender than in female, single on all segments but the terminal three. Genitalia as figured. Genital filaments a little more than three times as long as pump. Cibarium as figured, probably with a complete row of smaller and finer teeth of similar type to those in the female, but only those figured visible in the available material.

Holotype female, slide 1151, Sansapor, Dutch New Guinea, 11 Sept. 1944, in tree buttresses at Mar village.

Allotype male, slide 1145, same data as holotype.

Paratypes, 13 males and 14 females, same locality, 11 Sept. and 28 Aug. 1944; 1 female, New Guinea, no other data.

PHLEBOTOMUS NOEMFORENSIS, sp. nov. (Figs. 26, 51–52, 73.)

Female. Wing length 1·40 to 1·53 mm. Mesonotum slightly infuscated. Dorsal abdominal hairs recumbent, at most with occasional erect hairs on the posterior margins of some tergites. Ventral hairs larger, semi-recumbent. Proboscis about equal to head height from vertex to base of clypeus. Third antennal segment and palpi as figured.

Newstead's scales in a small dense patch on proximal third of third palpal segment. Ascoids paired on all but the terminal three flagellar segments (which are abruptly shorter than the preceding segments), slender, short and subequal, as figured. Pharynx not widened posteriorly, unarmed, with faint ridges and obscure digitate processses. Cibarium broad, bearing a comb of about 18 pointed teeth, as figured. Spermathecae not well preserved, apparently thin-walled ovoid structures with the terminal knob sunk in a pit.

Male. Wing length 1·13 to 1·20 mm. Similar to the female, but delta and alpha relatively shorter and wing narrower. Ascoids more slender and shorter, single on each flagellar segment except the last three, from which they appear to be absent. Genitalia of the *Sergentomyia* type, all spines of the style close to apex and aedeagus long and slender. Genital filaments a little more than twice as long as pump. Cibarium much like that of female, but narrower, the teeth smaller, about 13 in number. Pharynx as in female.

Holotype female, slide 1167, Kornosoren, Noemfor Island, Geelvink Bay, Dutch New Guinea, 12 Sept. 1944. Ferguson and Graham colls.

Allotype male, slide 1174, same data as holotype.

Paratypes, 34 males, 11 females, same data as holotype.

References.

Fairchild, G. B., and Hertig, Marshall, 1947.—Notes on the *Phlebotomus* of Panama. I. The subgenus *Brumptomyia*. *Ann. Ent. Soc. Amer.*, 40 (4) : 610-616.

———, 1948.—An improved method for mounting small insects. *Science*, 108 (2792) : 20-21.

Ferguson, M. S., and Graham, Owen H., 1948.—*Phlebotomus* in New Guinea and nearby islands. *Trans. Roy. Soc. Trop. Med. Hygiene*. 41 (5) : 679-684, 2 figs.

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Tonnoir, A. L., 1935.—The Australian species of the genus *Phlebotomus*. *Bull. Ent. Res.*, 26 : 137-147, 3 text-figs. and 1 plate.

Note.—For the sake of those who may be stimulated to follow the lead of Dr. Fairchild's work, it is worth recording that the range of distribution of *Phlebotomus* in Australia is quite wide. Mr. K. R. Norris has recently drawn attention to the existence of specimens, collected by himself, from both Western Australia and South Australia. These specimens were originally examined by Mr. Tonnoir, who determined the one from Crawley, W.A., as *Phlebotomus* near *queenslandi* Hill, and the one from the Waite Institute, Adelaide, S. Aust., as *Phlebotomus englisi* Tonn.? These are now in the C.S.I.R.O. collection at Canberra. During the present year Mr. A. L. Dyce has recovered *Phlebotomus* in a light trap he has been operating at Moree, N.S.W.—Ed.

AUSTRALIAN RUST STUDIES.

IX. PHYSIOLOGIC RACE DETERMINATIONS AND SURVEYS OF CEREAL RUSTS.

By W. L. Waterhouse,
The University of Sydney.

(Plate ix.)

[Read 30th July, 1952.]

Synopsis.

In continuation of earlier work, studies of the life histories and specialization phenomena have been made of the stem and leaf rusts of wheat, oats, barley, and rye. The host range has had to be extended to other grasses in many cases.

In general the aecidial stages of the pathogens are unimportant here. The carry-over of the rust takes place in the uredospore stage on self-sown plants of the cereal host or sometimes on susceptible grasses.

The physiologic races and, in certain cases, the biotypes of these rusts, have been determined during a long period of years and their occurrence surveyed for Australia and New Zealand. The bearing of this work on breeding programmes is emphasized.

General.

Cereal rusts do enormous damage throughout the world. In Australia, studies have been in progress for a number of years, and although results of earlier work have been published (Waterhouse, 1929, 1930, 1933, 1934, 1935, 1936, 1938, 1939, 1951; Waterhouse and Watson, 1941; Watson and Waterhouse, 1949), a detailed account of the later investigations has not been given for some time. This paper is designed to bring up to date the results that have been obtained with the following rusts: stem and leaf rust of wheat, stem and leaf rust of oats, leaf rust of rye, and leaf rust of barley. Results of work on certain grass rusts are not included here.

STEM RUST OF WHEAT.

Introduction.

Weather conditions in recent years have again been responsible for heavy crop losses from disease attack, and these have directed attention to the continuing importance of the wheat rust problem. Butler (1948) estimated that the New South Wales losses caused by stem rust in the 1947–1948 season amounted to £7,000,000, and pointed out that this would have been much greater had it not been for the cultivation of several resistant varieties in some areas. Further heavy losses have occurred since. Apart altogether from rust, other organisms have done much damage under the favourable conditions. It is difficult to give a true assessment of particular losses: some put down to stem rust may well have been due to other causes.

Life History.

Aecidial Stage.

Earlier work with *Puccinia graminis tritici* E. & H. (Waterhouse, 1929, 1936, 1938) has shown that the Australian position is unique in many ways. For example, the rust does not regularly develop the aecidial stage on the barberry. To date only one record of the natural occurrence of this stage has been made (Waterhouse, 1934). Nevertheless controlled work in the plant house has shown that the barberry is a potential source of danger, and the growing of susceptible species is rightly proscribed.

Material sent from other countries for examination has consistently given good germinations of teleutospores which have been over-wintered abroad before being forwarded by air mail in the spring. There have been a few cases, e.g., wheat straw from Greece, in which all attempts have failed to break the dormancy, either by exposing to winter conditions on the Tablelands, or by artificial freezing and thawing, material

which had not been thus treated. Year after year Australian material has been exposed to winter conditions on the Tablelands of New South Wales, and also treated in the refrigerator, but very rarely has it been possible to get the spores to germinate. Failures have occurred with spores formed in the spring and in the autumn and therefore not subjected to the high summer temperatures, as well as with rust produced at the usual times. There is a clear need for a fuller investigation of this happening: proper control of teleutospore germination is essential for studies dealing with the genetics of the rust fungi.

Teleutospores on wheat straw from India have yielded cultures from barberries which proved to be races 16 and 21.

Wheat rust sent for determination from Burma in 1947 showed the presence of races 14, 17 and 78. Reference is made elsewhere (p. 235) to the leaf rusts also present in this material.

British material has given many different races. It has already been stated (Waterhouse, 1938) that races 23, 24, 27, 33, 35, 51, 53, 69, 83, 109, 117 and 122 have been sorted out. In more recent work, the following additional races have been determined from teleutospore and uredospore material: 10, 11, 16, 21, 34, 48, 56, 75, 95, 100, 107, 148, 151, 194, 222 and 228.

This is a very wide range of races. Relatively few isolates have been available for examination, but the number of races found is very much greater than in comparable studies of Australian material. The greater diversity is probably due to the presence of the barberry in parts of Britain, and the production on it of new races by hybridization.

It has been the practice to test the overseas races for their reactions on useful extra-differential varieties—viz., "Yalta", "Celebration", and "Eureka". Uniformly resistant reactions have been given on "Yalta", this being in sharp contrast with the susceptibility shown to the common Australian rust. On "Celebration", instead of resistance, susceptibility is usual. There have been cases—e.g., with r. 34—in which isolates giving the normal reactions on the differential set have behaved quite differently on "Celebration", one biotype giving fully susceptible and another completely resistant reactions. "Eureka" is resistant to some but susceptible to others of these races. This again emphasizes the fact that varieties useful as resistant parents in one area may be quite worthless in another where different physiologic races occur. At the same time it is important to have the greatest possible number of races on hand for work designed to classify the genes that are concerned with resistance, as well as to enable tests for wide resistance to be made of new crossbred wheats. The more genes for resistance that are present, the more likely is such a variety to remain resistant under changes that take place in the races present in that area.

Uredospore Stage.

Evidence has mounted to show that the uredospore stage carries the rust over from season to season on "volunteer" wheat, barley, rye, and on certain grasses. During the period under consideration the occurrences on common grasses in time and space are shown in Tables 1 and 2.

It is clear that with the exception of 1945, which was a drought year, rusted grasses came to hand in each of the years. The significance of the widely distributed *Hordeum leporinum* and *Agropyron scabrum* is shown by the fact that they provided more than 90% of the isolates. By reason of its perennial habit, the latter is particularly important. The relative paucity of rusts from the other grasses does not mean that they are therefore unimportant. Thus the other two species of *Hordeum* and the three of *Agropyron* listed have a limited distribution only, but where they do occur they may serve as foci for the spread of the rust. It should not be taken that the grasses listed are the only ones capable of being attacked by wheat stem rust. Further investigation may well bring others to light.

Apart from its occurrence on wheat and grasses, stem rust has commonly been found on rye and barley, sometimes on plants growing out of season. Details of these isolates are set out in Tables 3 and 4.

TABLE 1.

Summary of the Number of Isolations of Physiologic Races of P. graminis tritici *Found on Grasses, Grouped According to Time of Collection.*

Race.	Season of Collection, Ending 31st March of the Year Named.													Totals.
	1939.	1940.	1941.	1942.	1943.	1944.	1945.	1946.	1947.	1948.	1949.	1950.	1951.	
21										1				1
45		1												1
59	1													1
126	13	11	8	5	2	8		1	2	6	2	3		61
126B								8	2	11	2	10	2	35
222BB												20	5	25
222AB												13	2	15
Totals	14	12	8	5	2	8		9	4	18	4	46	9	139

TABLE 2.

Summary of the Number of Isolations of Physiologic Races of P. graminis tritici *Found on Grasses, Grouped According to Their Source.*

Grass Host.	Total No. of Isolates.	Source of Material and Number of Each Race Found.													Totals of Races.						
		A.C.T.		N.S.W.						Qld.			S.A.		W.A.							
		Races.		Races.						Races.			Races.		Race.							
		126.	45.	21.	59.	126.	126B.	222BB.	222AB.	126.	126B.	222BB.	126.	126B.	126.	21.	45.	59.	126.	126B.	222BB.	222AB.
Hordeum leporinum	95	2			1	28	24	18	11				1	1	9			1	40	25	18	11
H. marinum ..	2					1	1												1	1		
H. bulbosum ..	2						2													2		
Agropyron scabrum	32	2	1			8	5	4	4	2	1	3			2		1		14	6	7	4
A. spicatum ..	1										1									1		
A. velutinum ..	1			1												1						
A. pectinatum ..	1					1													1			
Amphibromus Neesii	1					1													1			
Elymus sp. ..	2					2													2			
Aegilops ovata ..	1														1				1			
Deyeuxia quadriseta	1					1													1			
Totals ..	139	4	1	1	1	42	32	22	15	2	2	3	1	1	12	1	1	1	61	35	25	15

In all but two of the years, rust was found on rye. From it four races were isolated. In one case, races 33 and 126 were present together in the one field collection. Race 126 was found in almost 90% of the isolates.

Barley was a host of wheat rust in each of the years. In all, seven races were found on it. On six occasions, races 126 and 126B were found together, once races 14 and 126B, and once races 33 and 126. The commonest race was 126, which occurred to the extent of 70% of the total.

TABLE 3.

Frequency of Occurrence and Distribution of Races of P. graminis tritici *on Rye.*

Year.	Race.	Number of Isolates.	Distribution in Space.					
			N.S.W.	Qld.	Vic.	S.A.	W.A.	N.Z.
1939	33	1		1				
	126	6	5	1				
1940	126	4	3				1	
1941	126	6	5					1
1942	126	6	6					
1943	126	3	3					
1944	126	3	3					
1945	126	4	4					
	126B	1	1					
1946	126	1	1					
	126B	2	1		1			
1947	126	1				1		
	126B	1	1					
1948	126	1	1					
1949	—							
1950	126	1	1					
	126B	1	1					
	222BB	1	1					
1951	—							
Totals ..		43	37	2	1	1	1	1

TABLE 4.

Frequency of Occurrence and Distribution of Races of P. graminis tritici *on Barley.*

Year.	Race.	Number of Isolates.	Distribution in Space.					
			N.S.W.	Qld.	Vic.	S.A.	W.A.	Tas.
1939	33	1		1				
	126	8	4	4				
1940	126	5	4	1				
1941	126	7	7					
1942	45	1	1					
	126	11	8				2	1
1943	126	4	3	1				
1944	126	11	5			1	5	
1945	126	1	1					
	126B	1	1					
1946	126	2	2					
	126B	3	3					
1947	126	3	2		1			
	126B	4	3			1		
1948	126	5	2	1			1	1
	126B	8	5	2		1		
	14	1	1					
1949	126	1	1					
	126B	1	1					
	222AA	1	1					
1950	126	2	2					
	126B	2	2					
1951	222BB	3	3					
	222AB	1	1					
Totals ..		87	63	10	1	3	8	2